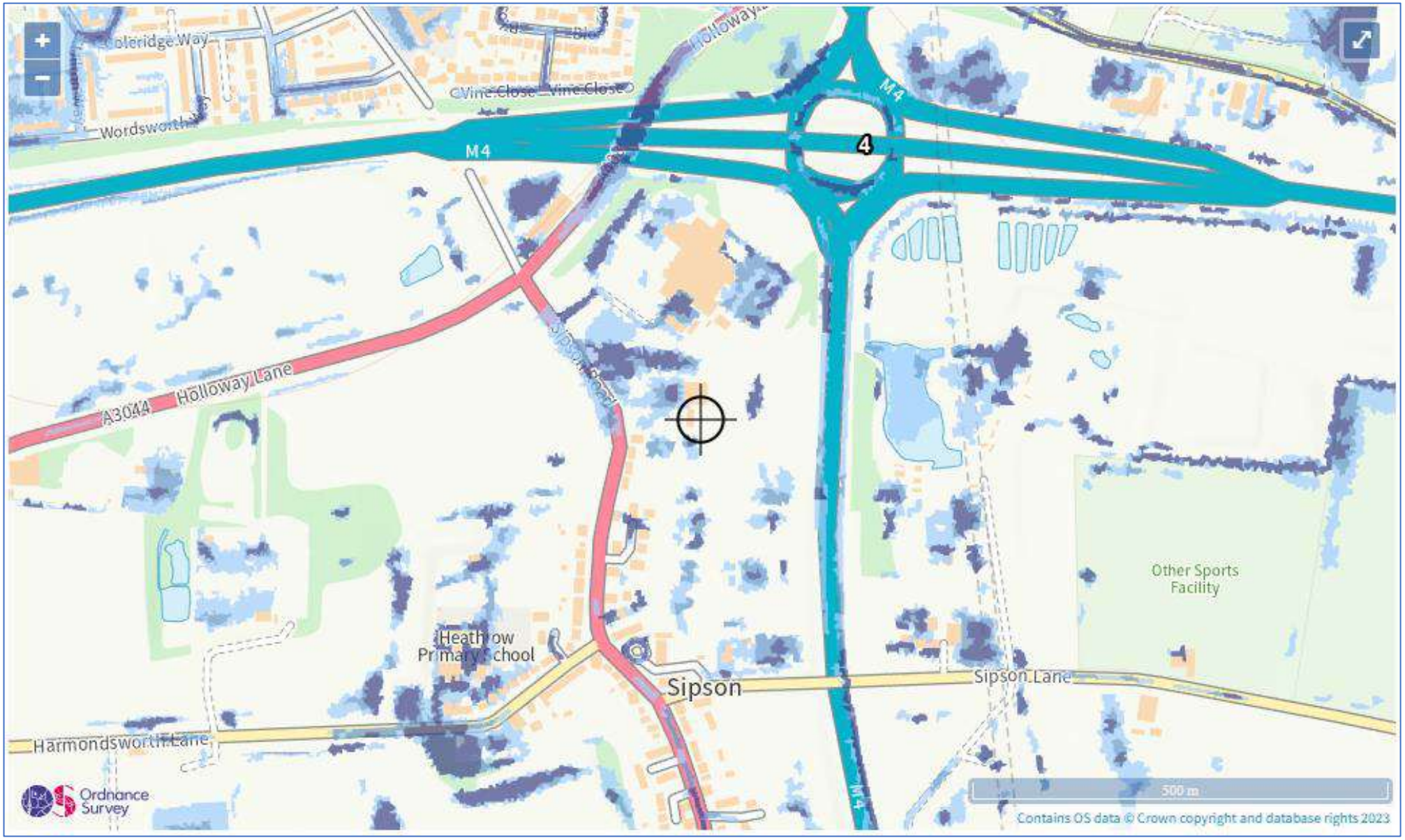
Appendix G

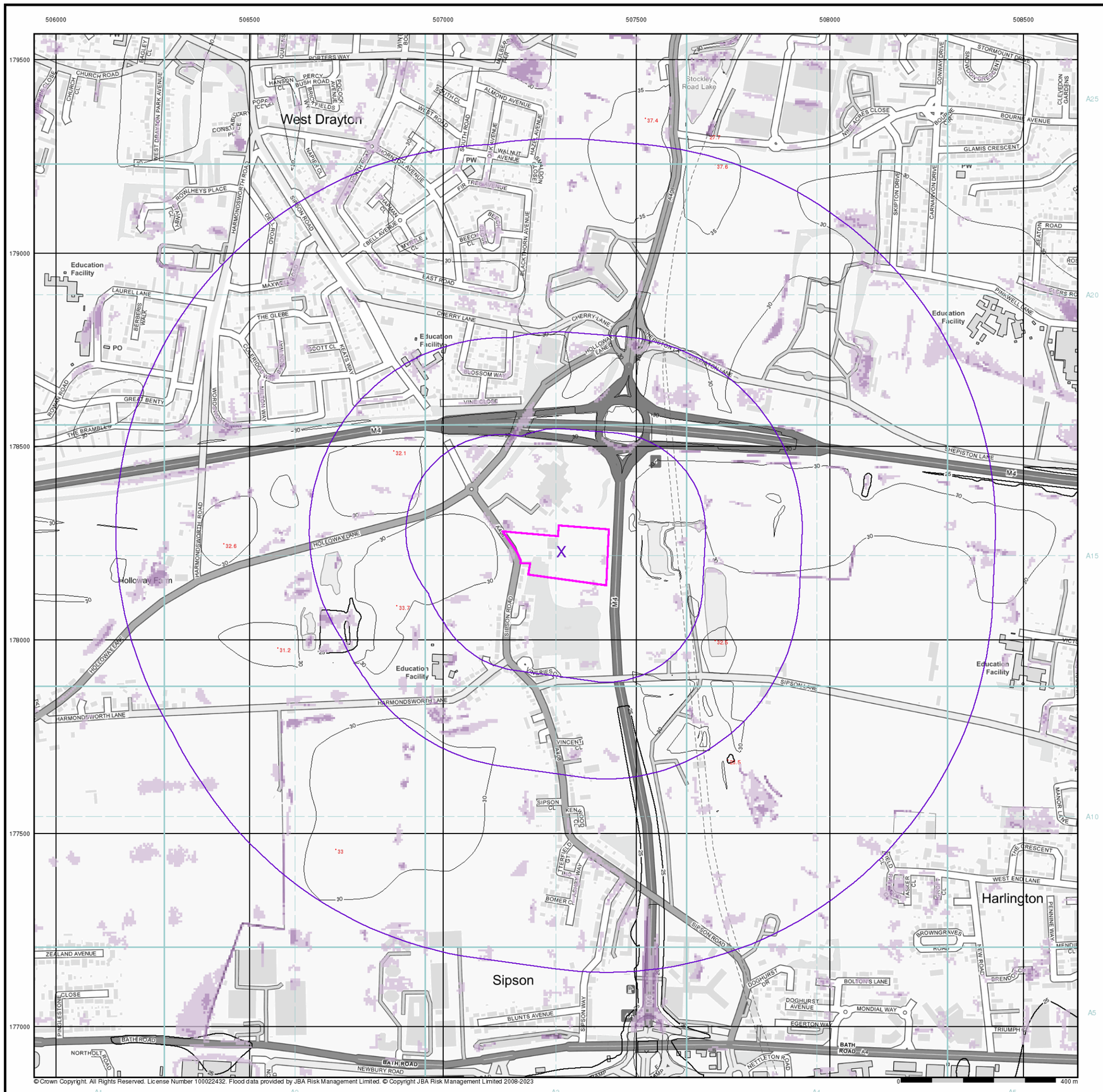
Risk of Flooding from Surface Water Mapping

Surface Water Flood Risk



Appendix H

JBA Pluvial Flood Risk Mapping



motion

JBA 75 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

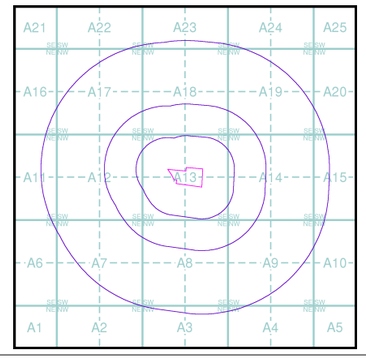
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 157.8

JBA 75 Year Return Flood Map (Undefended) - Slice A



Order Details

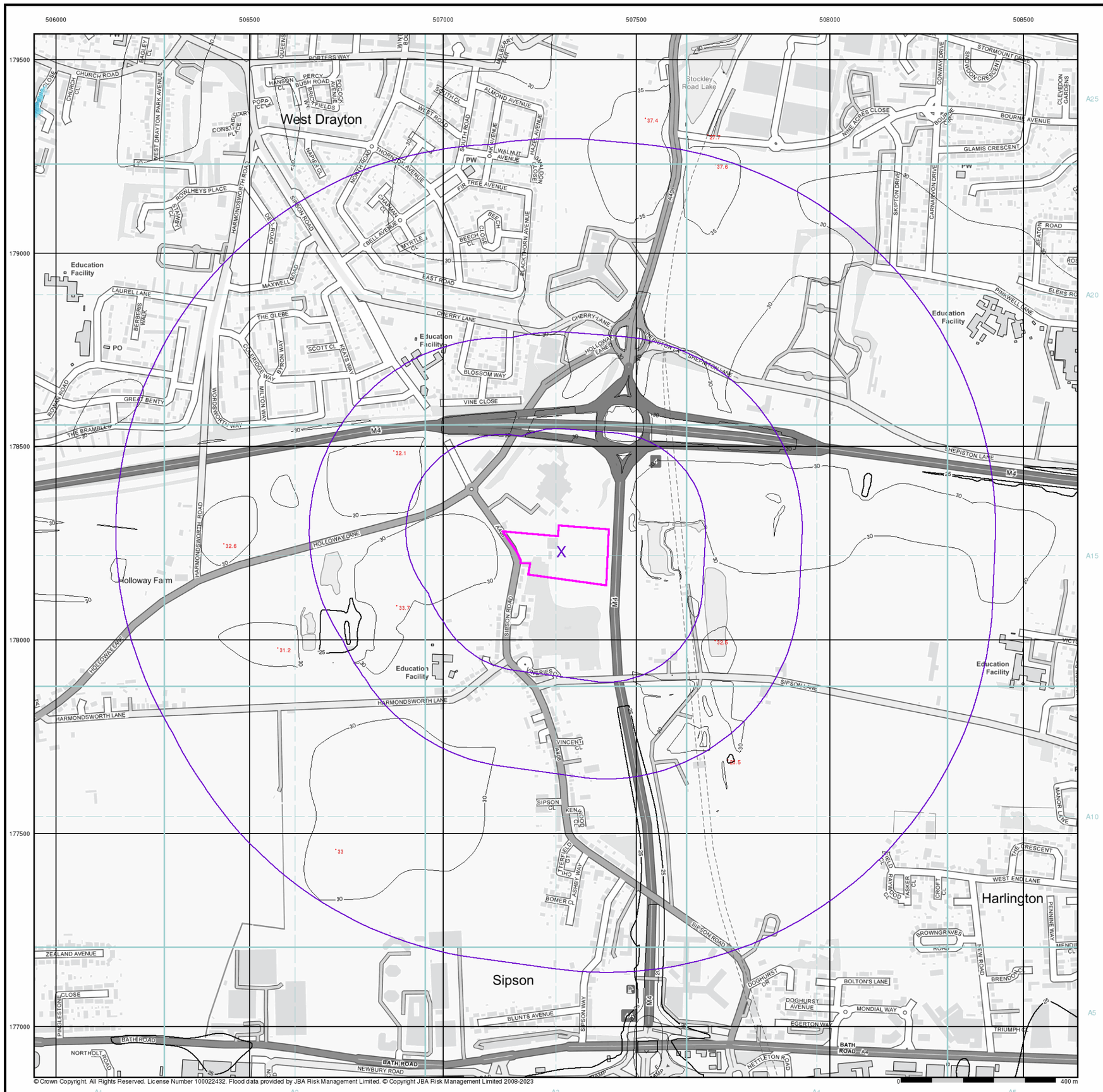
Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

The Plough, 239, Sipson Road, Sipson, WEST DRAYTON, UB7 0HW

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



motion

JBA 100 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Modelled Flood Depth

Fluvial Depth	Coastal Depth
0.01m - 0.05m	0.01m - 0.05m
0.05m - 0.1m	0.05m - 0.1m
0.1m - 0.3m	0.1m - 0.3m
0.3m - 1m	0.3m - 1m
>1m	>1m

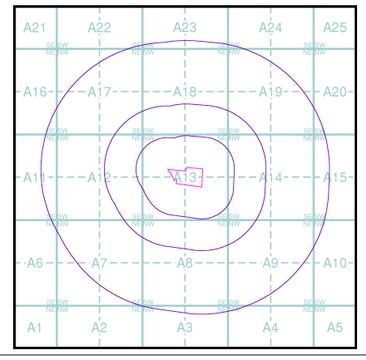
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 167.8

JBA 100 Year Return Flood Map (Undefended) - Slice A



Order Details

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Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
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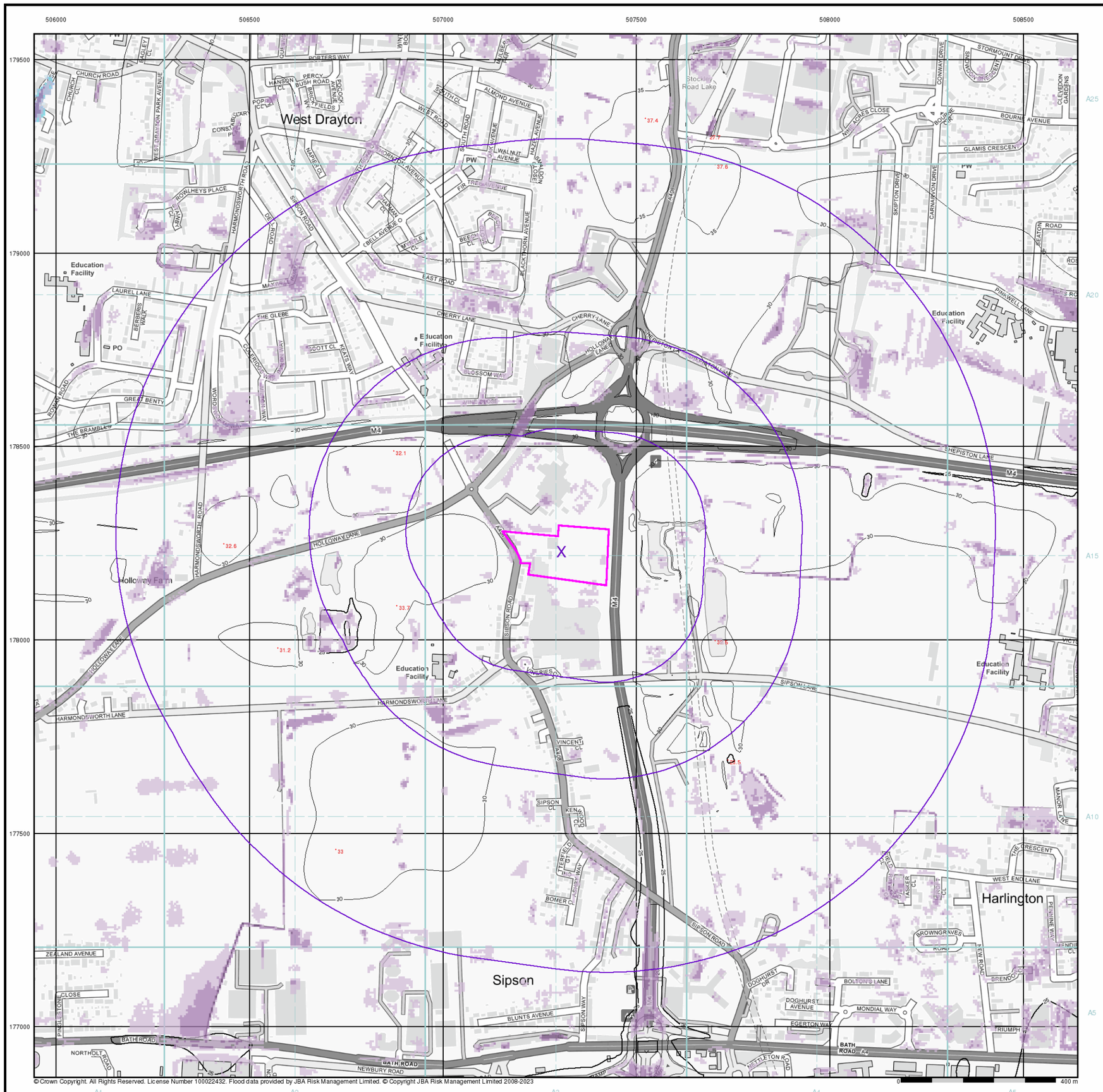


motion

JBA 200 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

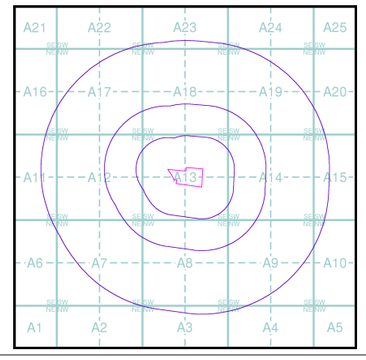
Contours (height in metres)

Standard Contour — 105 — 100 — 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height * 157.8

JBA 200 Year Return Flood Map (Undefended) - Slice A



Order Details

Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

The Plough, 239, Sipson Road, Sipson, WEST DRAYTON, UB7 0HW

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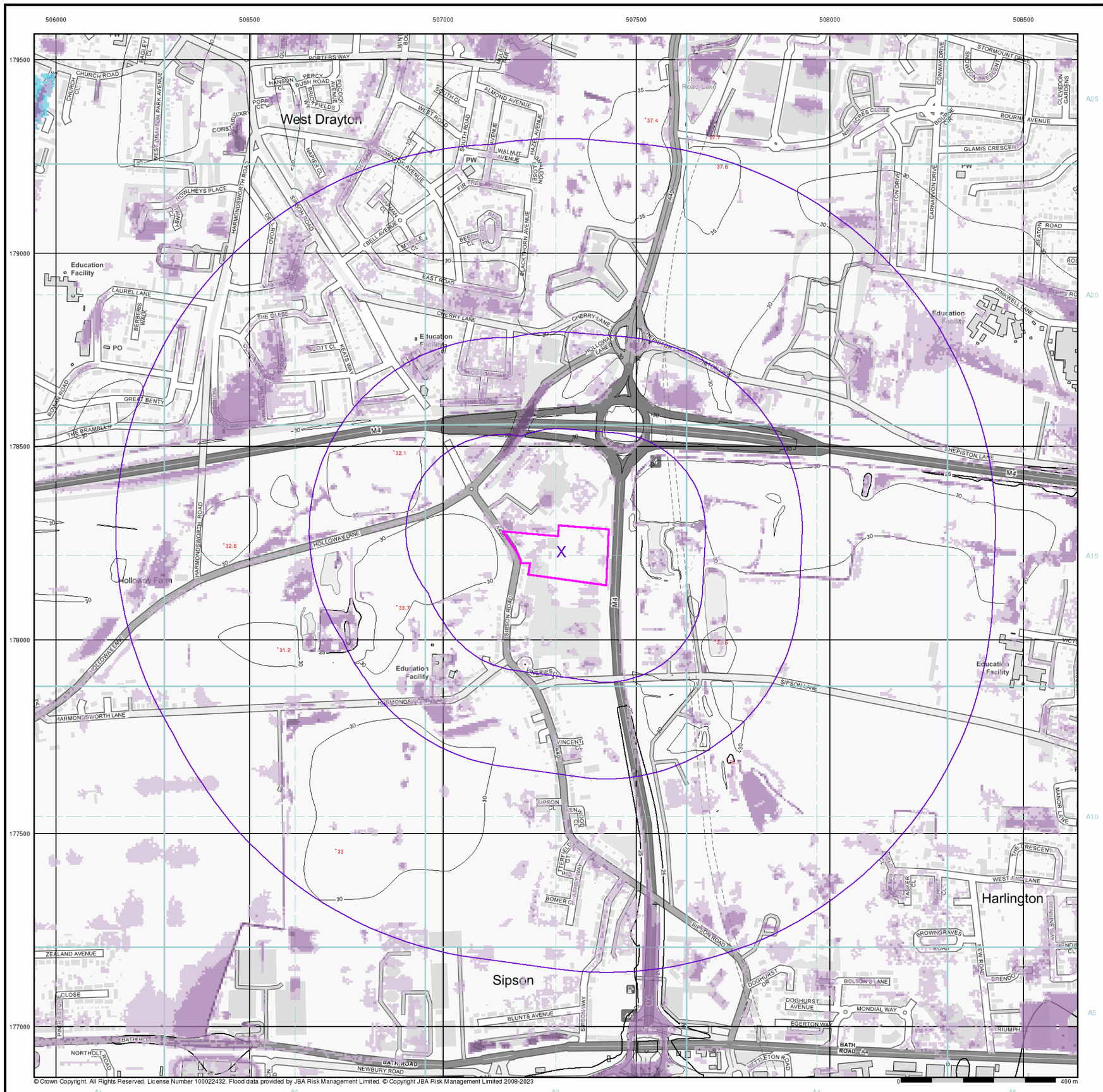
Web: www.envirocheck.co.uk



motion

JBA 1000 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

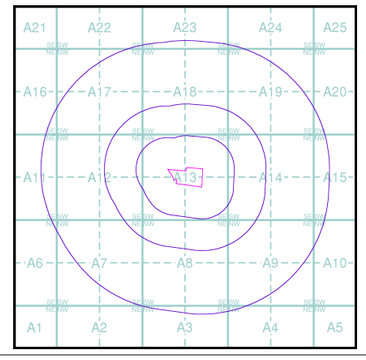
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 157.8

JBA 1000 Year Return Flood Map (Undefended) - Slice A



Order Details

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Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

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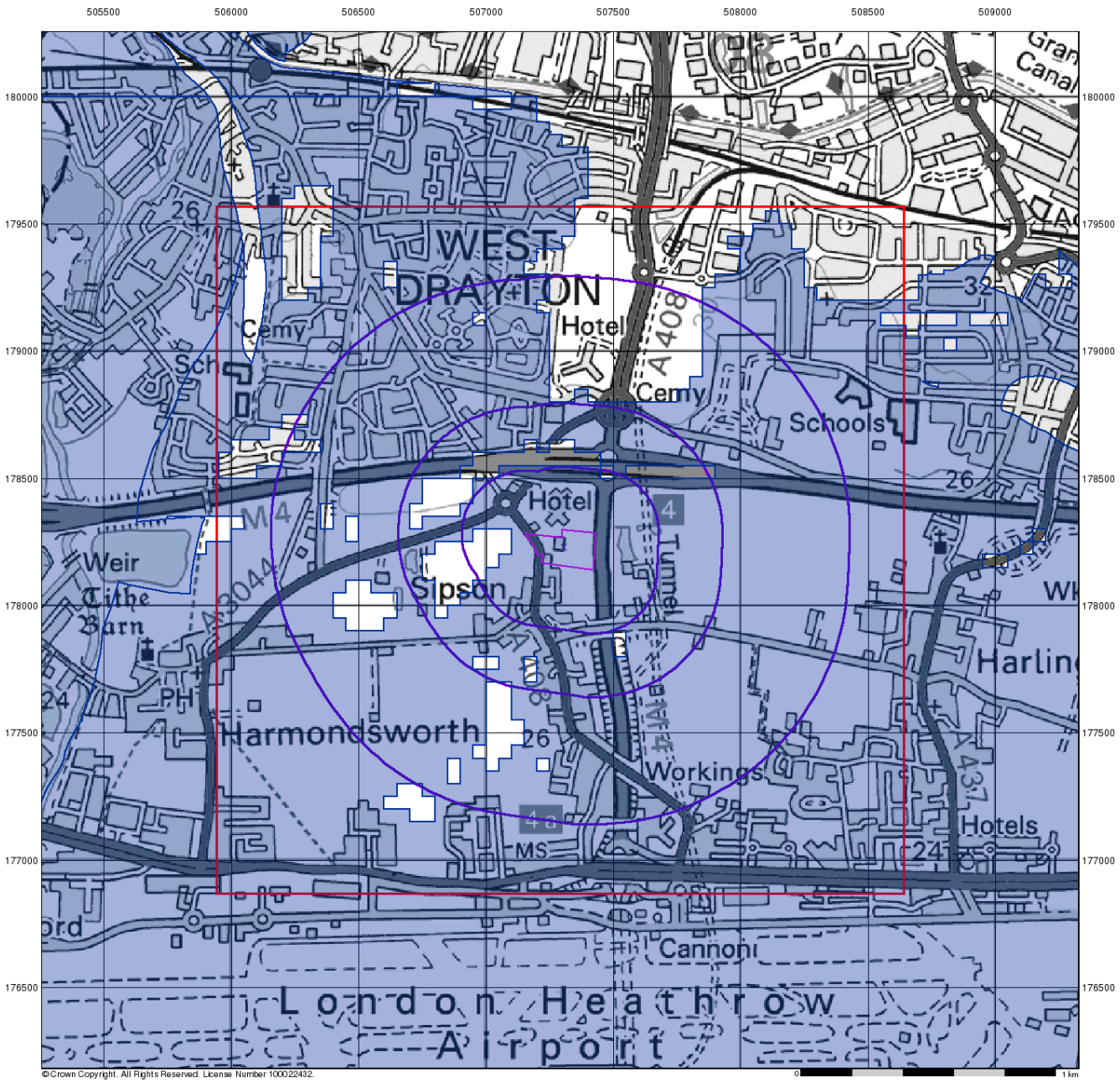
Appendix I

Groundwater Susceptibility Mapping



motion

BGS Flood Data (1:50,000)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

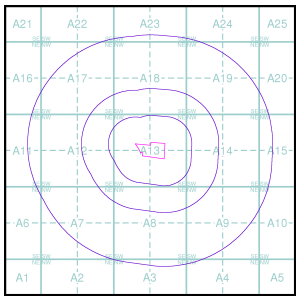
BGS Geological Indicators of Flooding

Coastal

Inland

Bodies of Water

BGS Flood Data Map - Slice A



Order Details

Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

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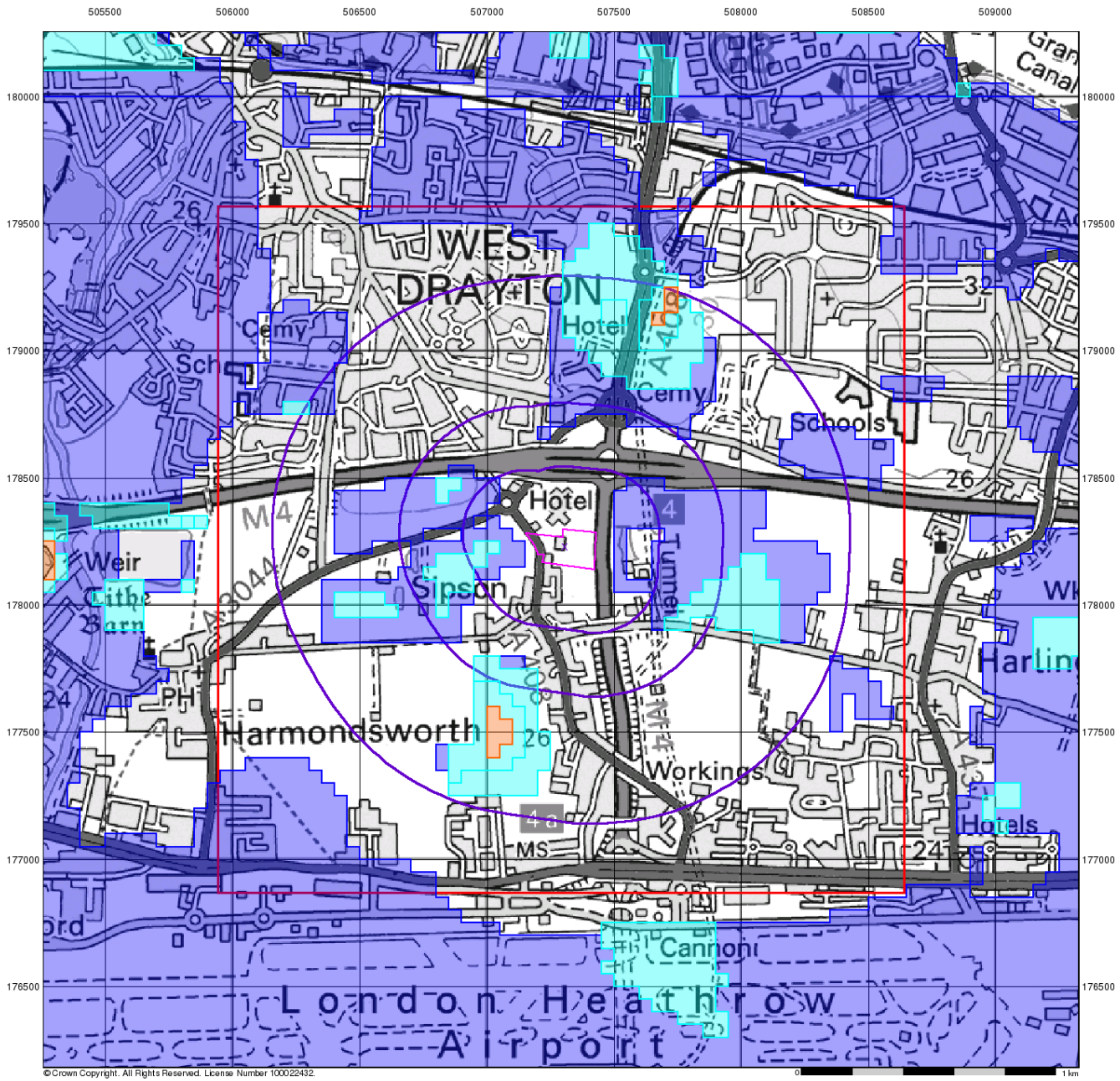
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



motion

BGS Flood Data (1:50,000)

General

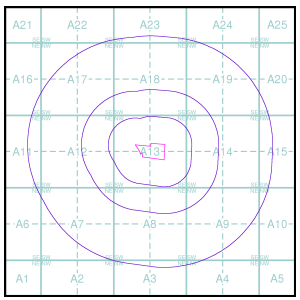
Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

BGS Groundwater Flooding Susceptibility

- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



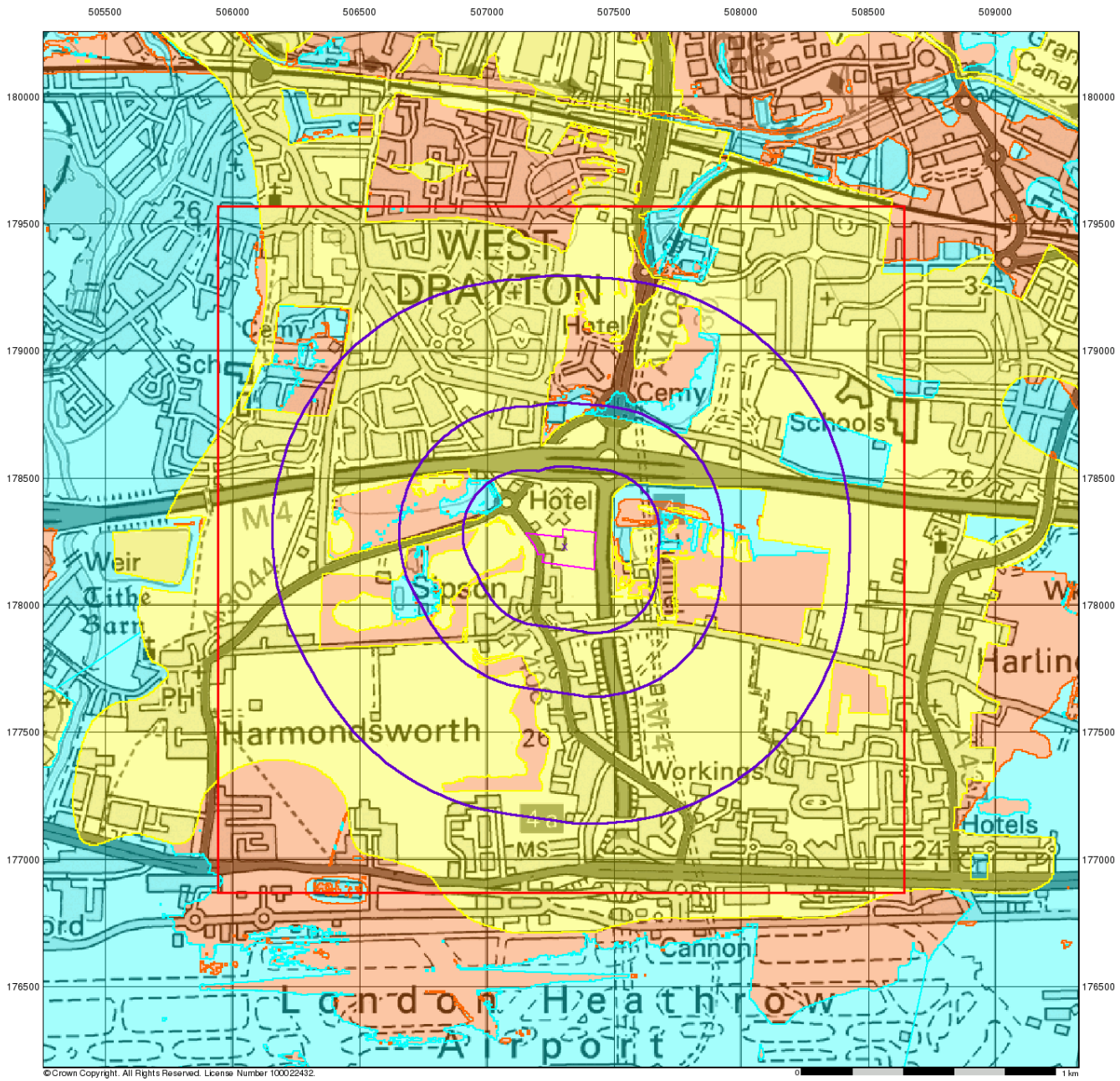
Order Details

Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

The Plough, 239, Sipson Road, Sipson, WEST DRAYTON, UB7 0HW

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



motion

GeoSmart Information Groundwater Flood Map (1:50,000)

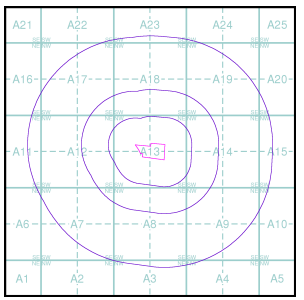
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice

GeoSmart Information Groundwater Flooding Risk

- High Risk
- Moderate Risk
- Low Risk
- Negligible Risk

GeoSmart Information Groundwater Flood Map - Slice A



Order Details

Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

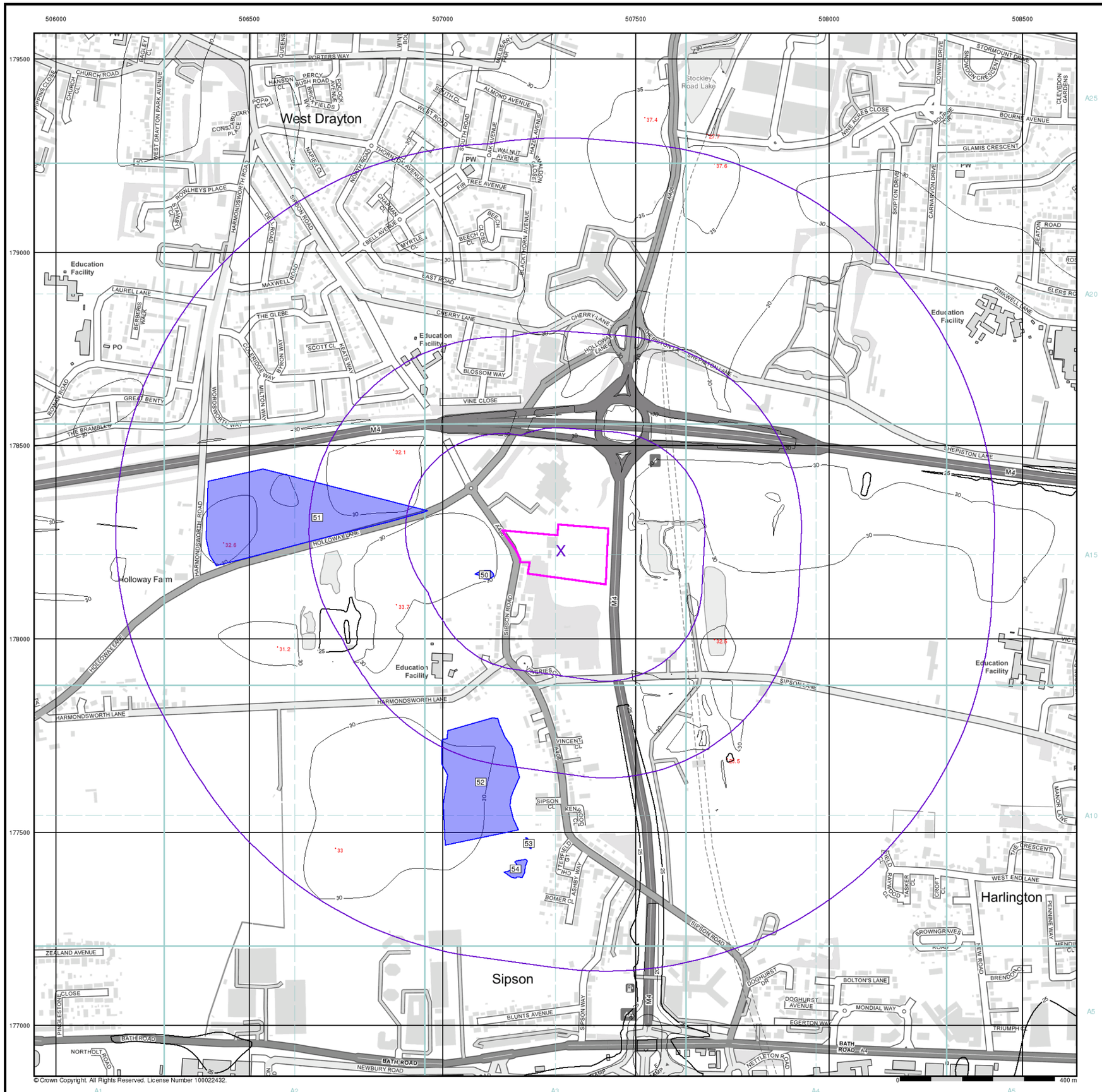
Site Details

The Plough, 239, Sipson Road, Sipson, WEST DRAYTON, UB7 0HW

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix J

Historic Flood Map



motion

EA/NRW Historic Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

Historic Flood Events Data

- Channel Capacity Exceeded (no raised defences)
- Channel Capacity Exceeded /Surface Water
- Groundwater/High Water Table
- Local Drainage/Surface Water
- Mechanical Failure
- Obstruction/Blockage - Bridge
- Obstruction/Blockage - Channel
- Historical Flood Liabilities
- Obstruction/Blockage - Culvert
- Obstruction/Blockage - Debris Screen
- Operational Failure/ Breach of Defence
- Other
- Overtopping of Defences
- Surface Water
- Unknown

Contours (height in metres)

Standard Contour 105 100 95

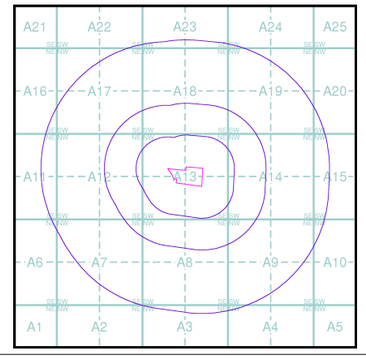
Master Contour

Spot Height *167.8

MLW Mean Low Water

MHW Mean High Water

EA/NRW Historic Flood Map - Slice A



Order Details

Order Number:	325185375_1_1
Customer Ref:	1bisip/2309013
National Grid Reference:	507310, 178230
Slice:	A
Site Area (Ha):	2.94
Search Buffer (m):	1000

Site Details

The Plough, 239, Sipson Road, Sipson, WEST DRAYTON, UB7 0HW

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix K

UKSuDS Greenfield Runoff Calculation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Phil Allen
Site name:	Sipson Centre of Excellence
Site location:	Sipson Road, Heathrow

Site Details

Latitude:	51.49292° N
Longitude:	0.45611° W
Reference:	3240532308
Date:	Dec 06 2023 12:52

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.642

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	615	615
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

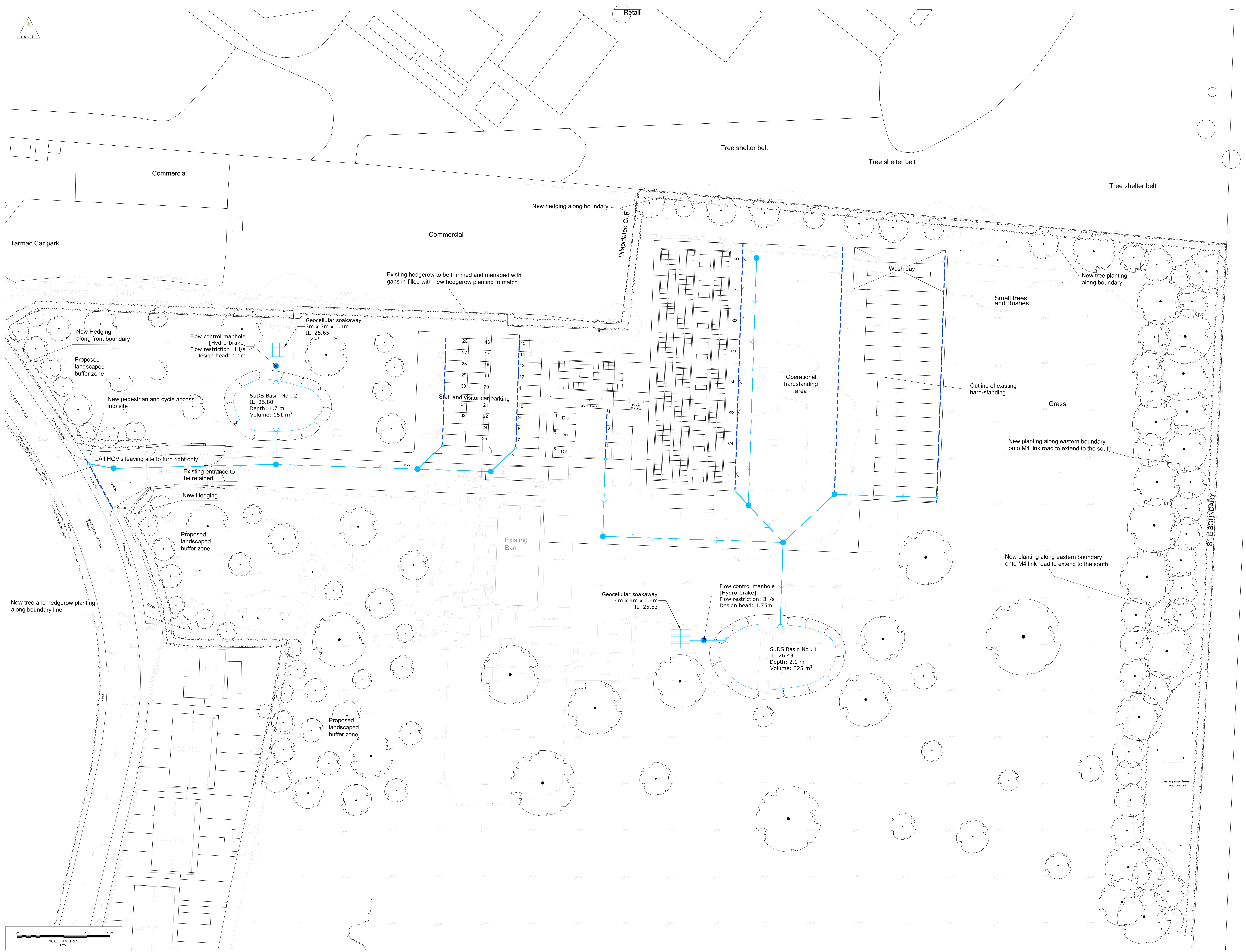
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.01	1.01
1 in 1 year (l/s):	0.85	0.85
1 in 30 years (l/s):	2.31	2.31
1 in 100 year (l/s):	3.21	3.21
1 in 200 years (l/s):	3.76	3.76

Appendix L

Proposed Drainage Strategy Layout



north
Retail
Commercial
Commercial
Tarmac Car park
Tree shelter belt
Tree shelter belt
Tree shelter belt
New hedging along boundary
Dilapidated CLF
Existing hedgerow to be trimmed and managed with gaps in-filled with new hedgerow planting to match
New Hedging along front boundary
Proposed landscaped buffer zone
Flow control manhole [Hydro-brake] Flow restriction: 1 l/s Design head: 1.1m
Geocellular soakaway 3m x 3m x 0.4m IL 25.65
SuDS Basin No . 2 IL 26.80 Depth: 1.7 m Volume: 151 m³
New pedestrian and cycle access into site
Staff and visitor car parking
All HGV's leaving site to turn right only
Existing entrance to be retained
New Hedging
Proposed landscaped buffer zone
SIPSON ROAD
Existing Barn
Wash bay
Operational hardstanding area
Outline of existing hard-standing
Small trees and Bushes
New tree planting along boundary
Grass
New planting along eastern boundary onto M4 link road to extend to the south
New planting along eastern boundary onto M4 link road to extend to the south
SITE BOUNDARY
Geocellular soakaway 4m x 4m x 0.4m IL 25.53
Flow control manhole [Hydro-brake] Flow restriction: 3 l/s Design head: 1.75m
SuDS Basin No . 1 IL 26.43 Depth: 2.1 m Volume: 325 m³
New tree and hedgerow planting along boundary line
Proposed landscaped buffer zone
Existing small trees and bushes
SCALE IN METRES 1:250

Notes

1. All levels and dimensions are to be checked on site before any work commences. All dimensions are in metres unless stated otherwise.
2. This drawing has been based upon survey information supplied by Digital Terrain Surveys LLP and Motion cannot guarantee the accuracy of the data provided.
3. This drawing should be read in conjunction with all other relevant architect and engineering details, drawings and specification.
8. All pipes shall be laid soffit to soffit with outgoing pipes unless otherwise stated.
9. Manholes and linear drainage systems situated within areas accessible to motor vehicles are to be fitted with suitable strength covers and frames.

Legend

- New Surface Water Gravity Pipe
- New Surface Water Linear Drainage System (Suitable for Heavy Vehicles)
- New Surface Water Manhole
- New Surface Water Flow Control Manhole
- New Surface Water Inspection Chamber
- New Pond
- New Cellular Soakaway

Rev.	Description	Drn	Chk	App	Date
A	First Issue	CC	CC	PA	22/12/2023

Drawing Status:
FOR PLANNING
NOT FOR CONSTRUCTION

motion
Guildford - Reading - London
www.motion.co.uk

Client: Lewdown Holdins Ltd

Project: Sipson Centre of Excellence, Sipson Road, Sipson

Title: Drainage Strategy

Scale: 1:250 (@ A0)

Drawing: 2309013-0501

Revision: A

Appendix M

MicroDrainage Network Hydraulic Model Results

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall (pipe 1.004)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.258	4-8	0.101

Total Area Contributing (ha) = 0.359

Total Pipe Volume (m³) = 13.019

Time Area Diagram at outfall (pipe 5.003)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.112	4-8	0.036

Total Area Contributing (ha) = 0.148

Total Pipe Volume (m³) = 4.143

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

Network Design Table for Storm

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	19.188	0.378	50.8	0.013	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	33.189	0.539	61.6	0.027	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	19.666	0.386	50.9	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	24.177	0.242	100.0	0.030	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	20.291	0.203	100.0	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	21.716	0.215	101.0	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	18.669	0.110	170.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	21.527	0.089	241.9	0.043	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	20.551	0.401	51.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	34.867	0.266	131.1	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.277	0.104	300.0	0.113	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.003	4.995	0.012	416.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	4.995	0.012	416.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.000	32.965	0.544	60.6	0.011	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	12.294	0.123	100.0	0.020	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	150.00	5.23	27.750	0.013	0.0	0.0	0.0	1.42	25.0	5.3
1.001	150.00	5.66	27.372	0.040	0.0	0.0	0.0	1.28	22.7	16.1
2.000	150.00	5.23	27.550	0.015	0.0	0.0	0.0	1.41	25.0	6.0
2.001	150.00	5.63	27.164	0.044	0.0	0.0	0.0	1.00	17.8«	18.0
3.000	150.00	5.34	27.450	0.014	0.0	0.0	0.0	1.00	17.8	5.6
3.001	150.00	5.70	27.247	0.041	0.0	0.0	0.0	1.00	17.7	16.7
3.002	150.00	6.01	26.957	0.070	0.0	0.0	0.0	1.00	39.8	28.5
2.002	149.46	6.37	26.772	0.157	0.0	0.0	0.0	1.01	71.1	63.7
4.000	150.00	5.24	27.500	0.000	0.0	0.0	0.0	1.41	24.9	0.0
4.001	150.00	5.75	27.024	0.049	0.0	0.0	0.0	1.14	45.3	20.0
1.002	145.41	6.81	26.533	0.359	0.0	0.0	0.0	1.17	185.8	141.5
1.003	144.68	6.90	26.429	0.359	0.0	0.0	0.0	0.99	157.5	141.5
1.004	143.95	6.98	26.417	0.359	0.0	0.0	0.0	0.99	157.5	141.5
5.000	150.00	5.42	27.600	0.011	0.0	0.0	0.0	1.29	22.9	4.6
6.000	150.00	5.20	27.550	0.020	0.0	0.0	0.0	1.00	17.8	8.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
6.001	6.631	0.067	99.0	0.019	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.002	15.344	0.153	100.0	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.000	12.212	0.122	100.0	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	6.346	0.171	37.1	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.003	30.105	0.226	133.4	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.001	8.749	0.036	243.0	0.049	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	8.749	0.036	243.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.003	2.728	0.011	248.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.001	150.00	5.31	27.427	0.038	0.0	0.0	0.0	1.01	17.8	15.6
6.002	150.00	5.57	27.360	0.048	0.0	0.0	0.0	1.00	17.8«	19.7
7.000	150.00	5.20	27.500	0.014	0.0	0.0	0.0	1.00	17.8	5.6
7.001	150.00	5.27	27.378	0.027	0.0	0.0	0.0	1.66	29.3	10.9
6.003	150.00	6.01	27.132	0.088	0.0	0.0	0.0	1.13	44.9	35.7
5.001	150.00	6.16	26.831	0.148	0.0	0.0	0.0	1.00	71.0	60.3
5.002	150.00	6.30	26.795	0.148	0.0	0.0	0.0	1.00	71.0	60.3
5.003	149.64	6.35	26.759	0.148	0.0	0.0	0.0	0.99	70.3	60.3

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	0	0.018	0.000	0.000
	User	-	100	0.013	0.013	0.013
1.001	User	-	0	0.031	0.000	0.000
	User	-	100	0.027	0.027	0.027
2.000	User	-	100	0.015	0.015	0.015
2.001	User	-	100	0.030	0.030	0.030
3.000	User	-	100	0.014	0.014	0.014
3.001	User	-	100	0.028	0.028	0.028
3.002	User	-	100	0.029	0.029	0.029
2.002	User	-	100	0.043	0.043	0.043
4.000	User	-	0	0.022	0.000	0.000
4.001	User	-	100	0.049	0.049	0.049
1.002	User	-	0	0.052	0.000	0.000
	User	-	100	0.069	0.069	0.069
	User	-	100	0.044	0.044	0.113
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.011	0.011	0.011
6.000	User	-	100	0.020	0.020	0.020
6.001	User	-	100	0.019	0.019	0.019
6.002	User	-	100	0.010	0.010	0.010
7.000	User	-	100	0.014	0.014	0.014
7.001	User	-	100	0.013	0.013	0.013
6.003	User	-	100	0.013	0.013	0.013
5.001	User	-	100	0.025	0.025	0.025
	User	-	100	0.024	0.024	0.049
5.002	-	-	100	0.000	0.000	0.000
5.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.630	0.508	0.508

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		28.530	26.405	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.003		28.450	26.748	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 4, DS/PN: 1.003, Volume (m³): 7.8

Unit Reference	MD-SHE-0073-3000-1750-3000
Design Head (m)	1.750
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	26.429
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.750	3.0	Kick-Flo®	0.650	1.9
Flush-Flo™	0.318	2.4	Mean Flow over Head Range	-	2.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.5	3.000	3.8	7.000	5.7
0.200	2.3	1.400	2.7	3.500	4.1	7.500	5.9
0.300	2.4	1.600	2.9	4.000	4.4	8.000	6.1
0.400	2.3	1.800	3.0	4.500	4.6	8.500	6.3
0.500	2.3	2.000	3.2	5.000	4.9	9.000	6.4
0.600	2.1	2.200	3.3	5.500	5.1	9.500	6.6
0.800	2.1	2.400	3.5	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

Pump Manhole: 13, DS/PN: 1.004, Volume (m³): 3.6

Invert Level (m) 26.417

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	0.0000	2.500	0.0000
0.200	0.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	0.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	0.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	0.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	0.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	0.0000	1.500	0.0000	2.300	0.0000		
0.800	0.0000	1.600	0.0000	2.400	0.0000		

Hydro-Brake® Optimum Manhole: 22, DS/PN: 5.002, Volume (m³): 2.5

Unit Reference	MD-SHE-0046-1000-1100-1000
Design Head (m)	1.100
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	46
Invert Level (m)	26.795
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	1.0	Kick-Flo®	0.408	0.6
Flush-Flo™	0.200	0.8	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.7	1.200	1.0	3.000	1.6	7.000	2.3
0.200	0.8	1.400	1.1	3.500	1.7	7.500	2.4
0.300	0.8	1.600	1.2	4.000	1.8	8.000	2.5
0.400	0.7	1.800	1.2	4.500	1.9	8.500	2.5
0.500	0.7	2.000	1.3	5.000	2.0	9.000	2.6
0.600	0.8	2.200	1.4	5.500	2.1	9.500	2.7
0.800	0.9	2.400	1.4	6.000	2.2		
1.000	1.0	2.600	1.5	6.500	2.2		

Pump Manhole: 12, DS/PN: 5.003, Volume (m³): 2.7

Invert Level (m) 26.759

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.900	0.0000	1.700	0.0000	2.500	0.0000
0.200	0.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	0.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	0.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	0.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	0.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	0.0000	1.500	0.0000	2.300	0.0000		
0.800	0.0000	1.600	0.0000	2.400	0.0000		

Storage Structures for Storm

Tank or Pond Manhole: 4, DS/PN: 1.003

Invert Level (m) 26.429

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	30.5	2.101	278.8

Cellular Storage Manhole: 13, DS/PN: 1.004

Invert Level (m) 25.530 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00360 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00360

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	16.0	16.0	0.401	0.0	22.4
0.400	16.0	22.4			

Tank or Pond Manhole: 22, DS/PN: 5.002

Invert Level (m) 26.795

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	10.0	1.780	159.6

Cellular Storage Manhole: 12, DS/PN: 5.003

Invert Level (m) 25.650 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00360 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00360

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	9.0	9.0	0.401	0.0	13.8
0.400	9.0	13.8			

Time Area Diagram for Green Roof at Pipe Number 1.000 (Storm)

Area (m³) 180 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003271	12	16	0.001795	24	28	0.000985	36	40	0.000541
4	8	0.002678	16	20	0.001470	28	32	0.000807	40	44	0.000443
8	12	0.002193	20	24	0.001203	32	36	0.000660	44	48	0.000362

Time Area Diagram for Green Roof at Pipe Number 1.000 (Storm)

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
48	52	0.000297	68	72	0.000109	88	92	0.000040	108	112	0.000015
52	56	0.000243	72	76	0.000089	92	96	0.000033	112	116	0.000012
56	60	0.000199	76	80	0.000073	96	100	0.000027	116	120	0.000010
60	64	0.000163	80	84	0.000060	100	104	0.000022			
64	68	0.000133	84	88	0.000049	104	108	0.000018			

Time Area Diagram for Green Roof at Pipe Number 1.001 (Storm)

Area (m³) 310 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.005633	32	36	0.001137	64	68	0.000230	96	100	0.000046
4	8	0.004612	36	40	0.000931	68	72	0.000188	100	104	0.000038
8	12	0.003776	40	44	0.000762	72	76	0.000154	104	108	0.000031
12	16	0.003092	44	48	0.000624	76	80	0.000126	108	112	0.000025
16	20	0.002531	48	52	0.000511	80	84	0.000103	112	116	0.000021
20	24	0.002072	52	56	0.000418	84	88	0.000084	116	120	0.000017
24	28	0.001697	56	60	0.000343	88	92	0.000069			
28	32	0.001389	60	64	0.000280	92	96	0.000057			

Time Area Diagram for Green Roof at Pipe Number 4.000 (Storm)

Area (m³) 220 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.003998	32	36	0.000807	64	68	0.000163	96	100	0.000033
4	8	0.003273	36	40	0.000661	68	72	0.000133	100	104	0.000027
8	12	0.002680	40	44	0.000541	72	76	0.000109	104	108	0.000022
12	16	0.002194	44	48	0.000443	76	80	0.000089	108	112	0.000018
16	20	0.001796	48	52	0.000363	80	84	0.000073	112	116	0.000015
20	24	0.001471	52	56	0.000297	84	88	0.000060	116	120	0.000012
24	28	0.001204	56	60	0.000243	88	92	0.000049			
28	32	0.000986	60	64	0.000199	92	96	0.000040			

Time Area Diagram for Green Roof at Pipe Number 1.002 (Storm)

Area (m³) 520 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time Area Diagram for Green Roof at Pipe Number 1.002 (Storm)

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.009449	32	36	0.001908	64	68	0.000385	96	100	0.000078
4	8	0.007737	36	40	0.001562	68	72	0.000315	100	104	0.000064
8	12	0.006334	40	44	0.001279	72	76	0.000258	104	108	0.000052
12	16	0.005186	44	48	0.001047	76	80	0.000211	108	112	0.000043
16	20	0.004246	48	52	0.000857	80	84	0.000173	112	116	0.000035
20	24	0.003476	52	56	0.000702	84	88	0.000142	116	120	0.000029
24	28	0.002846	56	60	0.000575	88	92	0.000116			
28	32	0.002330	60	64	0.000470	92	96	0.000095			

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	1.131	0.339	0.000	1.470
1.001	2	1.558	0.586	0.000	2.145
2.000	3	1.131	0.348	0.000	1.479
2.001	4	1.511	0.427	0.000	1.938
3.000	5	1.131	0.359	0.000	1.490
3.001	6	1.191	0.384	0.000	1.575
3.002	7	1.519	0.742	0.000	2.261
2.002	5	1.841	1.522	0.000	3.363
4.000	9	1.131	0.363	0.000	1.494
4.001	6	1.896	1.386	0.000	3.282
1.002	3	2.744	4.974	0.000	7.718
1.003	4	3.007	0.794	281.295	285.097
1.004	13	3.025	0.794	6.085	9.904
5.000	16	1.131	0.583	0.000	1.714
6.000	20	1.131	0.217	0.000	1.348
6.001	18	1.100	0.117	0.000	1.218
6.002	18	1.233	0.271	0.000	1.504
7.000	19	1.131	0.216	0.000	1.347
7.001	19	1.213	0.112	0.000	1.325
6.003	18	1.434	1.197	0.000	2.631
5.001	18	1.888	0.618	0.000	2.506
5.002	22	2.013	0.618	124.423	127.055
5.003	12	2.139	0.193	3.423	5.754
Total		37.228	17.162	415.226	469.616

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 20, 20

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	60 Winter	1	+0%	30/960 Winter				27.766
1.001	2	60 Winter	1	+0%	30/120 Winter				27.400
2.000	3	15 Winter	1	+0%	30/240 Winter				27.580
2.001	4	1440 Winter	1	+0%	30/15 Summer				27.287
3.000	5	15 Winter	1	+0%	30/240 Summer				27.484
3.001	6	15 Winter	1	+0%	30/60 Winter				27.304
3.002	7	1440 Winter	1	+0%	1/960 Winter				27.287
2.002	5	1440 Winter	1	+0%	1/480 Winter				27.287
4.000	9	60 Winter	1	+0%	30/240 Winter				27.518
4.001	6	1440 Winter	1	+0%	1/1440 Winter				27.287
1.002	3	1440 Winter	1	+0%	1/240 Winter				27.287
1.003	4	1440 Winter	1	+0%	1/120 Winter				27.287
1.004	13	1440 Winter	1	+0%	1/120 Winter				27.286
5.000	16	1440 Winter	1	+0%	30/60 Winter				27.628
6.000	20	1440 Winter	1	+0%	30/30 Winter				27.628
6.001	18	1440 Winter	1	+0%	1/1440 Winter				27.628
6.002	18	1440 Winter	1	+0%	1/960 Summer				27.628

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.134	0.000	0.03			0.6	OK	
1.001	2	-0.122	0.000	0.08			1.7	OK	
2.000	3	-0.120	0.000	0.09			2.0	OK	
2.001	4	-0.027	0.000	0.02			0.3	OK	
3.000	5	-0.116	0.000	0.11			1.9	OK	
3.001	6	-0.093	0.000	0.31			5.1	OK	
3.002	7	0.105	0.000	0.02			0.5	SURCHARGED	
2.002	5	0.215	0.000	0.02			1.2	SURCHARGED	
4.000	9	-0.132	0.000	0.03			0.8	OK	
4.001	6	0.038	0.000	0.01			0.5	SURCHARGED	
1.002	3	0.304	0.000	0.01			2.2	SURCHARGED	
1.003	4	0.408	0.000	0.00			0.5	SURCHARGED	
1.004	13	0.419	0.000	0.00			0.0	SURCHARGED	
5.000	16	-0.122	0.000	0.00			0.1	OK	
6.000	20	-0.072	0.000	0.01			0.2	OK	
6.001	18	0.051	0.000	0.02			0.3	SURCHARGED	
6.002	18	0.118	0.000	0.02			0.4	SURCHARGED	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	19	1440 Winter	1	+0%	30/30 Winter				27.628
7.001	19	1440 Winter	1	+0%	1/960 Winter				27.628
6.003	18	1440 Winter	1	+0%	1/240 Winter				27.628
5.001	18	1440 Winter	1	+0%	1/15 Summer				27.628
5.002	22	1440 Winter	1	+0%	1/15 Summer				27.628
5.003	12	1440 Winter	1	+0%	1/30 Summer				27.627

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	19	-0.022	0.000	0.01			0.1	OK	
7.001	19	0.100	0.000	0.01			0.2	SURCHARGED	
6.003	18	0.272	0.000	0.01			0.6	SURCHARGED	
5.001	18	0.497	0.000	0.02			1.0	SURCHARGED	
5.002	22	0.533	0.000	0.01			0.3	SURCHARGED	
5.003	12	0.568	0.000	0.00			0.0	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 20, 20

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	1440 Winter	30	+20%	30/960 Winter				28.048
1.001	2	1440 Winter	30	+20%	30/120 Winter				28.048
2.000	3	1440 Winter	30	+20%	30/240 Winter				28.048
2.001	4	1440 Winter	30	+20%	30/15 Summer				28.048
3.000	5	1440 Winter	30	+20%	30/240 Summer				28.048
3.001	6	1440 Winter	30	+20%	30/60 Winter				28.048
3.002	7	1440 Winter	30	+20%	1/960 Winter				28.048
2.002	5	1440 Winter	30	+20%	1/480 Winter				28.048
4.000	9	1440 Winter	30	+20%	30/240 Winter				28.048
4.001	6	1440 Winter	30	+20%	1/1440 Winter				28.048
1.002	3	1440 Winter	30	+20%	1/240 Winter				28.048
1.003	4	1440 Winter	30	+20%	1/120 Winter				28.048
1.004	13	1440 Winter	30	+20%	1/120 Winter				28.048
5.000	16	1440 Winter	30	+20%	30/60 Winter				28.213
6.000	20	1440 Winter	30	+20%	30/30 Winter				28.213
6.001	18	1440 Winter	30	+20%	1/1440 Winter				28.213
6.002	18	1440 Winter	30	+20%	1/960 Summer				28.213

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.148	0.000	0.01			0.3	SURCHARGED	
1.001	2	0.526	0.000	0.04			0.9	SURCHARGED	
2.000	3	0.348	0.000	0.01			0.3	SURCHARGED	
2.001	4	0.734	0.000	0.04			0.7	SURCHARGED	
3.000	5	0.448	0.000	0.02			0.3	SURCHARGED	
3.001	6	0.651	0.000	0.04			0.7	FLOOD RISK	
3.002	7	0.866	0.000	0.03			1.1	FLOOD RISK	
2.002	5	0.976	0.000	0.04			2.6	SURCHARGED	
4.000	9	0.398	0.000	0.02			0.4	SURCHARGED	
4.001	6	0.799	0.000	0.03			1.2	SURCHARGED	
1.002	3	1.065	0.000	0.03			5.5	SURCHARGED	
1.003	4	1.169	0.000	0.01			0.7	SURCHARGED	
1.004	13	1.181	0.000	0.00			0.0	SURCHARGED	
5.000	16	0.463	0.000	0.01			0.2	SURCHARGED	
6.000	20	0.513	0.000	0.02			0.3	SURCHARGED	
6.001	18	0.636	0.000	0.04			0.6	FLOOD RISK	
6.002	18	0.703	0.000	0.05			0.8	FLOOD RISK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	19	1440 Winter	30	+20%	30/30 Winter				28.213
7.001	19	1440 Winter	30	+20%	1/960 Winter				28.213
6.003	18	1440 Winter	30	+20%	1/240 Winter				28.213
5.001	18	1440 Winter	30	+20%	1/15 Summer				28.213
5.002	22	1440 Winter	30	+20%	1/15 Summer				28.213
5.003	12	1440 Winter	30	+20%	1/30 Summer				28.212

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	19	0.563	0.000	0.01			0.2	FLOOD RISK	
7.001	19	0.685	0.000	0.02			0.4	FLOOD RISK	
6.003	18	0.857	0.000	0.03			1.4	FLOOD RISK	
5.001	18	1.082	0.000	0.05			2.4	FLOOD RISK	
5.002	22	1.118	0.000	0.01			0.5	SURCHARGED	
5.003	12	1.153	0.000	0.00			0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 20, 20

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	1440 Winter	100	+20%	30/960 Winter				28.291
1.001	2	1440 Winter	100	+20%	30/120 Winter				28.291
2.000	3	1440 Winter	100	+20%	30/240 Winter				28.291
2.001	4	1440 Winter	100	+20%	30/15 Summer				28.291
3.000	5	1440 Winter	100	+20%	30/240 Summer				28.291
3.001	6	1440 Winter	100	+20%	30/60 Winter				28.291
3.002	7	1440 Winter	100	+20%	1/960 Winter				28.291
2.002	5	1440 Winter	100	+20%	1/480 Winter				28.291
4.000	9	1440 Winter	100	+20%	30/240 Winter				28.291
4.001	6	1440 Winter	100	+20%	1/1440 Winter				28.291
1.002	3	1440 Winter	100	+20%	1/240 Winter				28.291
1.003	4	1440 Winter	100	+20%	1/120 Winter				28.291
1.004	13	1440 Winter	100	+20%	1/120 Winter				28.291
5.000	16	1440 Winter	100	+20%	30/60 Winter				28.399
6.000	20	1440 Winter	100	+20%	30/30 Winter				28.398
6.001	18	1440 Winter	100	+20%	1/1440 Winter				28.398
6.002	18	1440 Winter	100	+20%	1/960 Summer				28.398

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.391	0.000	0.02			0.4	SURCHARGED	
1.001	2	0.769	0.000	0.05			1.1	SURCHARGED	
2.000	3	0.591	0.000	0.01			0.3	FLOOD RISK	
2.001	4	0.977	0.000	0.05			0.9	FLOOD RISK	
3.000	5	0.691	0.000	0.02			0.3	FLOOD RISK	
3.001	6	0.894	0.000	0.05			0.8	FLOOD RISK	
3.002	7	1.109	0.000	0.04			1.5	FLOOD RISK	
2.002	5	1.219	0.000	0.05			3.3	FLOOD RISK	
4.000	9	0.641	0.000	0.02			0.5	FLOOD RISK	
4.001	6	1.042	0.000	0.04			1.6	SURCHARGED	
1.002	3	1.308	0.000	0.04			7.1	FLOOD RISK	
1.003	4	1.412	0.000	0.01			0.9	FLOOD RISK	
1.004	13	1.424	0.000	0.00			0.0	FLOOD RISK	
5.000	16	0.649	0.000	0.01			0.2	FLOOD RISK	
6.000	20	0.698	0.000	0.03			0.4	FLOOD RISK	
6.001	18	0.821	0.000	0.05			0.8	FLOOD RISK	
6.002	18	0.888	0.000	0.06			1.0	FLOOD RISK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	19	1440 Winter	100	+20%	30/30 Winter				28.399
7.001	19	1440 Winter	100	+20%	1/960 Winter				28.399
6.003	18	1440 Winter	100	+20%	1/240 Winter				28.399
5.001	18	1440 Winter	100	+20%	1/15 Summer				28.399
5.002	22	1440 Winter	100	+20%	1/15 Summer				28.399
5.003	12	1440 Winter	100	+20%	1/30 Summer				28.398

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	19	0.749	0.000	0.02			0.3	FLOOD RISK	
7.001	19	0.871	0.000	0.02			0.5	FLOOD RISK	
6.003	18	1.042	0.000	0.04			1.8	FLOOD RISK	
5.001	18	1.268	0.000	0.06			3.2	FLOOD RISK	
5.002	22	1.304	0.000	0.01			0.6	FLOOD RISK	
5.003	12	1.339	0.000	0.00			0.0	FLOOD RISK	

Appendix N

Drainage Management and Maintenance Plan

Sipson Centre of Excellence for Airside Support Vehicles
Sipson Road, Sipson

Drainage Management and Maintenance Plan

For

Lewdown Holdings Ltd

motion

Document Control Sheet

Sipson Centre of Excellence for Airside Support Vehicles

Sipson Road, Sipson

Lewdown Holdings Ltd

This document has been issued and amended as follows:

Date	Issue	Prepared by	Approved by
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2.0 Maintenance Categories 2
3.0 The Surface Water Drainage System 3
4.0 General Maintenance Principles 4
5.0 Inspection and Maintenance Frequency of Components 6

1.0 Introduction

1.1 This document sets out the principles for the long-term management and maintenance of the proposed surface water drainage system on the proposed development at the Sipson Centre of Excellence.

1.2 The purpose of this document is to ensure that the site management company or their agents have a robust inspection and maintenance plan going forwards. This ensures the optimum operation of the surface water drainage system and that it will be continually maintained for the lifetime of the development. This will contribute to reducing the risk of surface water flooding both on- and off-site.

1.3 All those responsible for maintenance should follow relevant health and safety legislation for all activities listed within this report (including lone working, if relevant). Method statements and risk assessments should always be undertaken and made available, if requested.

1.4 This document has been produced by Motion on behalf of their client, Lewdown Holdings Ltd. This document describes the typical management and maintenance tasks that are known at the design stage (maintenance frequencies and typical tasks, for example). These have been drawn from industry guidance such as CIRIA C753 - The SuDS Manual – and manufacturer's own guidance.

1.5 Maintenance is considered as a construction activity under the CDM Regulations 2015. Under the CDM Regulations, it is a requirement that a competent person be appointed to carry out a required role. CDM defines a competent person as an individual with sufficient knowledge of the specific tasks to be undertaken, as well as sufficient experience and ability to carry out their duties in relation to the task in a way that secures health and safety on site.

1.6 In recognition of the requirements of the CDM Regulations 2015, this surface water management and maintenance plan expects that the maintenance work will be carried out by a competent person who must have prior knowledge of the drainage components and SuDS systems on site.

1.7 There are limitations on what this document can prescribe at this time. At this stage this document cannot specify the individuals who will carry out the maintenance and what equipment will be used. Related to this, this document is unable to provide method statements for exactly how maintenance practices will be carried out. These can only be determined at the time of the maintenance being carried out and the exact maintenance need, which will also be influenced by the maintenance method statement and safe systems of work. Therefore, this is to be the responsibility of the site management company and/or the individuals carrying out the work. We urge those who are carrying out the maintenance to record this information and make it available to the Local Planning Authority (LPA), if required to do so. This drainage management and maintenance plan needs to be a living document that is owned and maintained by the adopting site management company.

2.0 Maintenance Categories

2.1 There are three categories of maintenance activities referred to in this report. These are:

Regular maintenance (including inspections and monitoring)

- Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including inspections, vegetation management, and litter, silt and debris removal.

Occasional maintenance

- Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal after storms is an example).

Remedial maintenance

- Remedial maintenance comprises of intermittent tasks that may be required to rectify faults associated with the system. The likelihood of faults can be minimised by correct installation, regular inspection and timely maintenance. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events and, as such, timings are difficult to predict.
- This document should be read in conjunction with the design drawings of the drainage system, so that the location and type of each feature can be recognised and understood.

3.0 The Surface Water Drainage System

3.1 The proposed surface water drainage system is made up of a number of components. These include:

- Manholes
- Pipes
- Catchpit manholes/silt traps
- Hydrobrakes
- SuDS Basins
- Geocellular Soakaway Tanks

3.2 All components should be installed in accordance with the manufacturer's instructions and to the levels/arrangement as defined on the designer's drawings. Not doing so will invalidate any warranty provided by the manufacturer.

3.3 All maintenance and cleaning must be carried out in accordance with manufacturer's recommendations and by competent and suitably qualified staff, as defined in the CDM regulations 2015.

4.0 General Maintenance Principles

4.1 All surface water drainage systems, whether piped gravity systems, Sustainable Drainage Systems (SuDS), or flow control devices and pumps, require regular maintenance to keep them working at their optimum efficiency and capacity. The maintenance of the surface water drainage system on the proposed development at the Sipson Centre of Excellence should be carried out alongside other regular maintenance tasks on site.

4.2 Timely and adequate maintenance will increase the lifespan of all the drainage components. Inadequate maintenance will do the reverse. Therefore, the projected lifespan and anticipated replacement date of each drainage component cannot be forecast at the time of this document being produced.

4.3 The site management company and/or their agents are responsible for the maintenance of the surface water drainage system.

4.4 Construction activities can create and discharge significant quantities of sediment that will quickly clog the surface water drainage system. Therefore, construction-stage sediment removal is required immediately post-construction. This may require several cleans of the system during the first year after installation. The construction site manager should assess this and carry out cleaning as necessary.

4.5 Catchpit manholes/silt traps will form part of the built drainage system. They will remove gross solids and the majority of silts. It is important that any debris build-up in the catchpit manholes/silt traps is removed at regular intervals. This will reduce the risk of the drainage system becoming silted up. It will maintain its design capacity and function.

4.6 Cleaning should also take place after large storms when there have been increased surface water flows and visible entrainment and deposition of debris.

4.7 An increased frequency of inspection and maintenance should be programmed into the autumn and winter months in acknowledgement that:

- Leaf fall from deciduous trees in autumn will result in an increased amount of leaf litter and an elevated blockage risk of drainage infrastructure.
- Increased rainfall during winter months will result in greater quantities of water moving through the drainage system and a greater input of silt and other debris.

4.8 Table 4.1, below, gives an overview of typical maintenance tasks and the frequency with which they need to be undertaken. Section 5 – Inspection and Maintenance Frequency of Components – will assign typical maintenance frequencies and tasks to the specific components used within the surface water drainage system used on the Sipson Centre of Excellence development.

Table 4.1: Typical maintenance tasks and frequencies

Activity	Indicative Frequency	Typical Tasks
Routine/regular maintenance	Monthly to annually	▸ Litter picking ▸ Silt removal ▸ Inspection of all inlets, outlets and control structures ▸ Weed removal and invasive plant control
Occasional maintenance	Annually up to 25 years	▸ Silt control around components ▸ Vegetation management around components ▸ Sweeping of pavement areas to remove surface silt ▸ Silt removal from catchpits, cellular storage structures
Remedial maintenance	As required	▸ Inlet/outlet repairs ▸ Erosion repairs ▸ Reinstatement of edgings ▸ Reinstatement following pollution ▸ Removal of silt build-up and leaf litter after storms ▸ Repair of vandalism ▸ Replacement of any blocked filter ▸ membranes/materials

5.0 Inspection and Maintenance Frequency of Components

5.1 Table 5.1 below lists each of the components used within the site's surface water drainage system. It suggests an indicative maintenance frequency for each component and ascribes typical maintenance tasks to them.

5.2 This list is not exhaustive, nor is it prescriptive. As mentioned in Section 3, additional, unscheduled maintenance may be required following adverse weather conditions or after autumn leaf falls. Additional maintenance tasks may be required to adequately clean and maintain individual components.

5.3 The list of components should be cross-referenced with the designer's drawings so that the location of each component can be identified.

5.4 It is the responsibility of the site management company and/or their agents to ensure that all necessary maintenance activities are carried out in a timely manner and that the design performance of each drainage component is preserved.

5.5 If there is any uncertainty regarding the correct and safe methods of cleaning, or what equipment should be used, the manufacturer should be consulted.

Table 5.1: Maintenance Frequency and Task for Drainage Components

Activity	Indicative Frequency	Anticipated Tasks
Pipes	As required	▸ Identify any pipes that may not be operating properly and employ a competent, qualified contractor to inspect using CCTV. ▸ If the pipe is blocked with silt or debris, the pipe should be jetted clean from an upstream access point. All silt and debris should be captured and removed at a downstream access point. ▸ Inspect once clean. ▸ If any other defects are encountered (cracks, displaced joints, root ingress), appropriate solutions should be discussed with a competent and qualified contractor. These services are usually provided by the same companies that offer CCTV surveys and pipe jetting services.
Manholes	Annually	▸ Inspect/identify any damage or areas that are not operating correctly ▸ Remove silt, litter, leaves and other detritus. ▸ Inspect once clean.
Catchpit Manholes/Silt Traps	Twice a year, before and after autumn/winter	▸ Inspect/identify any damage or areas that are not operating correctly ▸ Remove silt, litter, leaves and other detritus. ▸ Inspect once clean.
Hydrobrake	Every three months for the first year, then annually thereafter	▸ Contact manufacturer for instruction on approved and safe inspection and maintenance practices. ▸ Inspect flow control device and check functionality. Remove any detritus as required. ▸ Inspect once clean.
SuDS Basin	Monthly in Summer, as required in Winter	▸ Responsibility should be with landscape contractors.

		▶ Maintenance tasks are not that different from standard public open space. ▶ Adequate access needs to be provided to the area. ▶ Regular mowing should take place across maintenance access routes, amenity areas, across embankments and the main storage area. Remaining areas can remain as 'meadow'. Mowed grass lengths of 75 – 100mm are appropriate. ▶ Grass clippings should be disposed of off-site. ▶ Any dead growth should be cleared before the start of the growing season. ▶ Any permanently wet areas with emergent aquatic vegetation should be managed as ponds or wetlands. ▶ Remove any sediment build-up as required. ▶ Check any inlets and outlets for blockages and clear as required. ▶ Check any flow control devices, if present.
Geocellular Soakaway Tanks	Annually	▶ Contact manufacturer for instruction on approved and safe inspection and maintenance practices. ▶ Inspect/identify any areas that are not operating correctly. ▶ Remove debris from catchment surface. ▶ Remove sediment from pre-treatment structures. ▶ Check for silt build-up and flush and remove as required (in accordance with manufacturer's instructions). ▶ Inspect once clean. ▶ See Table 21.3 of CIRIA C753 for more information. ▶ Most geocellular units have a 60-year creep limited life expectancy, so they should be planned for replacement by 2085 (approx.).

5.6 Upon completion of maintenance activities, a record should be kept of the work carried out. This should be retained, and an annual maintenance report should be compiled, which should include the following:

- Observations resulting from inspections.
- Maintenance and operation activities undertaken during the year.
- Recommendations for inspections and maintenance programmes for the following year.

5.7 On the last page of this document is a table with suggested information should be recorded and included with the maintenance plan. As mentioned in the introduction to this document, this should be a living document and regularly updated, as required.

Date	Component requiring maintenance	Issues prompting maintenance	Scheduled maintenance (Y/N)	Maintenance carried out	Additional works required (Y/N). If yes, please detail	Next scheduled date of inspection and maintenance

Appendix O

Hillingdon Council SuDS Proforma

The London Sustainable Drainage Proforma

Introduction

This proforma is intended to accompany a drainage strategy prepared for a planning application where required by national or local planning policy. It should be used to summarise the key outputs from the strategy to allow assessing officers at the Lead Local Flood Authority (LLFA) to quickly assess compliance with sustainable drainage (SuDS) planning

The proforma is divided into 4 sections, which are intended to be used as follows:

1. Site and project information - Provide summary details of the development, site and drainage
2. Proposed discharge arrangement – Summarise site ground conditions to determine potential for infiltration. Select a surface water discharge method (or mix of methods) following the hierarchical approach set out in the London Plan.
3. Drainage strategy – Prioritise SuDS measures that manage runoff as close to source as possible and contribute to the four main pillars of SuDS; amenity, biodiversity, water quality and water quantity.
4. Supporting information – Provide cross references to the page or section of the drainage strategy report where the detailed information to support each element can be found. This may be more than one reference for each

Policy

Drainage strategies for developments in the London Borough of Hillingdon need to comply with the following policies on SuDS:

1. London Borough of Hillingdon Local Plan policies EM 6 and DMEI 10
2. London Plan policy 5.13 and draft New London Plan policy SI13
3. The National Planning Policy Framework (NPPF)

Technical Guidance

- Post-development surface water discharge rate should be limited to greenfield runoff rates. Proposals for higher discharge rates should be agreed with the LLFA ahead of submission of the Planning Application. Clear evidence should be provided with the Planning Application to show why greenfield rates cannot be achieved.
- Greenfield runoff rate is the runoff rate from a site in its natural state, prior to any development. This should be calculated using one of the runoff estimation methods set out in Table 24.1 of CIRIA C753 The SuDS Manual.
- Attenuation storage volumes required to reduce post-development discharge rates to greenfield rates should be calculated using one of the runoff estimation methods set out in Table 24.1 of CIRIA C753 The SuDS Manual.
- 'CC' refers to climate change allowance from the current Environment Agency guidance.
- An operation and maintenance strategy for proposed SuDS measures should be submitted with the Planning Application and include the details set out in section 32.2 of CIRIA C753 The SuDS Manual. The manual should be site-specific and not directly reproduce parts of The SuDS Manual.
- Other useful sources of guidance are:
  - London Borough of Hillingdon sustainable drainage requirements
  - The London Plan Sustainable Design and Construction SPG
  - DEFRA non-statutory technical standards for sustainable drainage
  - Environment Agency climate change guidance
  - CIRIA C753 The SuDS Manual

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1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	Former Sipson Garden Centre (Sipson Centre of Excellence)
Address & post code	A408 Sipson Road, Sipson, West Drayton, London, (UB7 0HP is nearest postcode)
OS Grid ref. (Easting, Northing)	E 507264
	N 178244
LPA reference (if applicable)	N/A
Brief description of proposed work	The current proposals feature a two-storey office building and a principal service centre formed of 8no. service bays.
Total site Area	29,807 m^2
Total existing impervious area	10,429 m^2
Total proposed impervious area	6,270 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	Unknown - no surface water sewers in local area. Presumed to run off attenuated to surround land and infiltrate where possible
Designer Name	Phil Allen MCIWEM C.WEM
Designer Position	Associate
Designer Company	Motion Consultants

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Langley Silt / Taplow Gravel Member
Bedrock geology classification	London Clay
Site infiltration rate	$1x10^{-6}$ (assumed) m/s
Depth to groundwater level	No groundwater in borehole records m below ground level
Is infiltration feasible?	Infiltration is considered to be feasible

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Green Roofs
2 use infiltration techniques, such as porous surfaces in non-clay areas	Y	Y
3 attenuate rainwater in ponds or open water features for gradual release	Y	Y
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	N	N
7 discharge rainwater to the combined sewer.	N	N

2c. Proposed Discharge Details

Proposed discharge location	Infiltration to the Taplow Gravel superficial geology, which was shown to be completely dry in borehole logs. BRE365 tests underway
Has the owner/regulator of the discharge location been consulted?	N/A

3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	1.01			
1 in 1	0.85	147.30	0	0
1 in 30	2.31	327.71	0	0
1 in 100	3.21	417.24	0	0
1 in 100 + CC			0	0
Climate change allowance used		20%	Hillingdon Council's Sustainable Drainage and SuDS guidance states that for commercial premises, surface water attenuation should be provided on site for up to the 1 in 100-year event plus 20 percent for climate change.	
3b. Principal Method of Flow Control		There is no off site discharge, so flow controls are not needed in the context of the question.		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^3)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		9.508
Green roofs	567	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	5,853	0	405.72
Attenuation tanks	0		0
Total	6,420	0	415.23

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	BRE365 testing is underway. Drainage strategy report para's 2.12 to 2.25
Drainage hierarchy (2b)	Drainage strategy report para's 7.13 to 7.67
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	N/A - No off site discharge
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Drainage strategy report Appendix M (MicroDrainage Network model results).
Proposed SuDS measures & specifications (3b)	Drainage strategy para's 7.21 to 7.41
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix B
Detailed drainage design drawings, including exceedance flow routes	Drainage layout plan is in Appendix L of the drainage strategy report.
Detailed landscaping plans	Landscape plans submitted by landscape architect - please refer to these
Maintenance strategy	Appendix N
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	Section 9 of the drainage strategy
b) biodiversity?	SuDs ponds improve both biodiversity and amenity
c) amenity?	